Final Project Report

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Data Source

In this project, we will be analyzing the storms in the North Atlantic Basin from the years 1980-2010. The data source will be from the IBTrACS dataset found in the following site:

"https://www.ncdc.noaa.gov/ibtracs/index.php?name=wmo-data"

From here, we will navigate down to the table under "Access", look at the Data Access File "Storms by Basin" under the Hurdat format, and click on "Basin.NA.ibtracs_hurdat.v03r06.hdat". The data source should be found under the link below:

"ftp://eclipse.ncdc.noaa.gov/pub/ibtracs/v03r06/wmo/hurdat_format/basin/Basin.NA.ibtracs_hurdat.v03r06.hdat"

Cleaning and Data Analysis

To analyze the data, we need to do some cleaning and processing of the raw data. To work with the data, we need to use the packages below

Here are the cleaned csv files

Storm Analysis per Year

Storms per year: we can see that the storm frequency fluctuates between about 10-12 storms per year, with an outlier in 2005 due to Hurricane Katrina

```
## stormsperyear
## 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
##   18   22    8    6   20   14   10   14   19   15   16   12   10   10   12
## 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
##   21   13    9   14   16   19   17   14   21   16   31   10   18   17   11
## 2010
##   23
```

Barplot of Storms Per Year
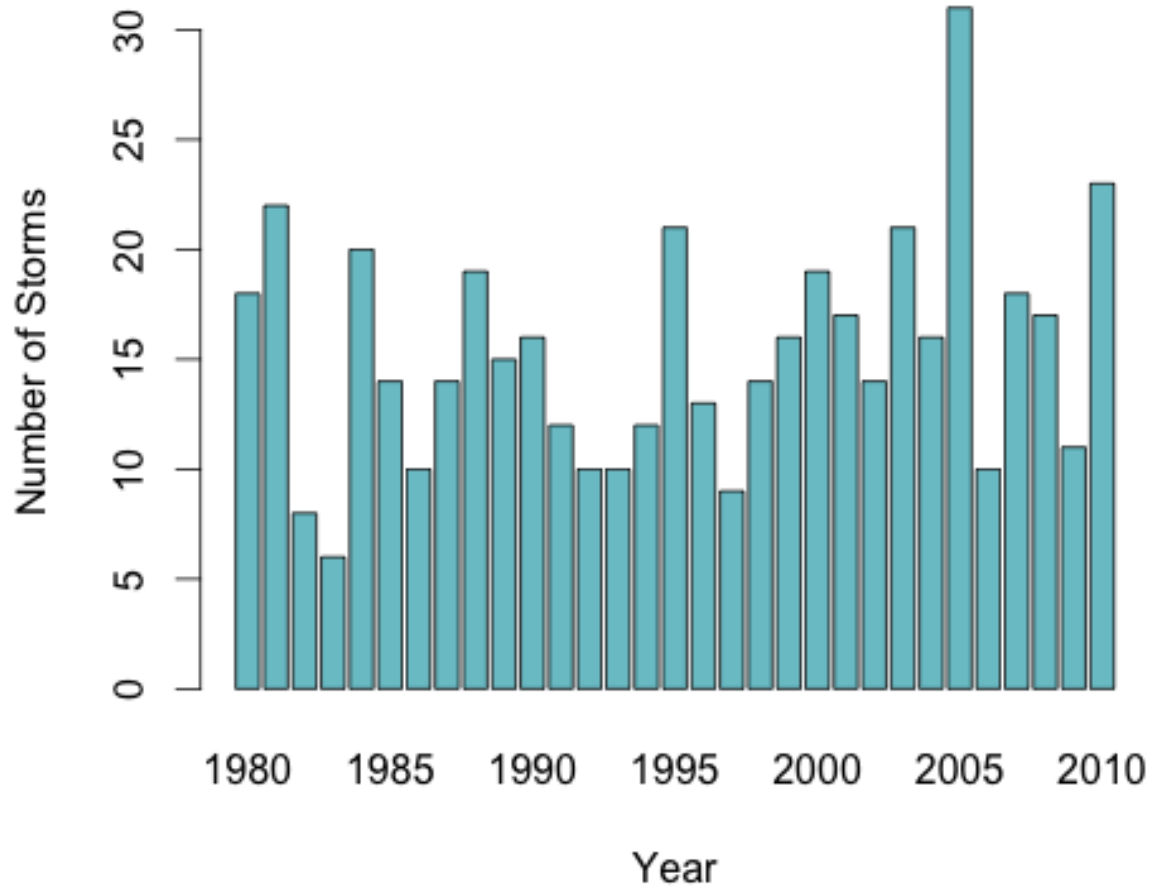
Storms with winds >= 35: we can see that the storms with winds >= 35 fluctuate between approximately 5 storms. The storms are in closer range; from this we can deduce that this is because weaker storms are more common.

```
## 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
##   11   12    6    4   13   11    6    7   12   11   14    8    7    9    7
## 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
##   19   13    8   14   12   15   15   12   16   15   29   10   17   16    9
## 2010
##   19
```
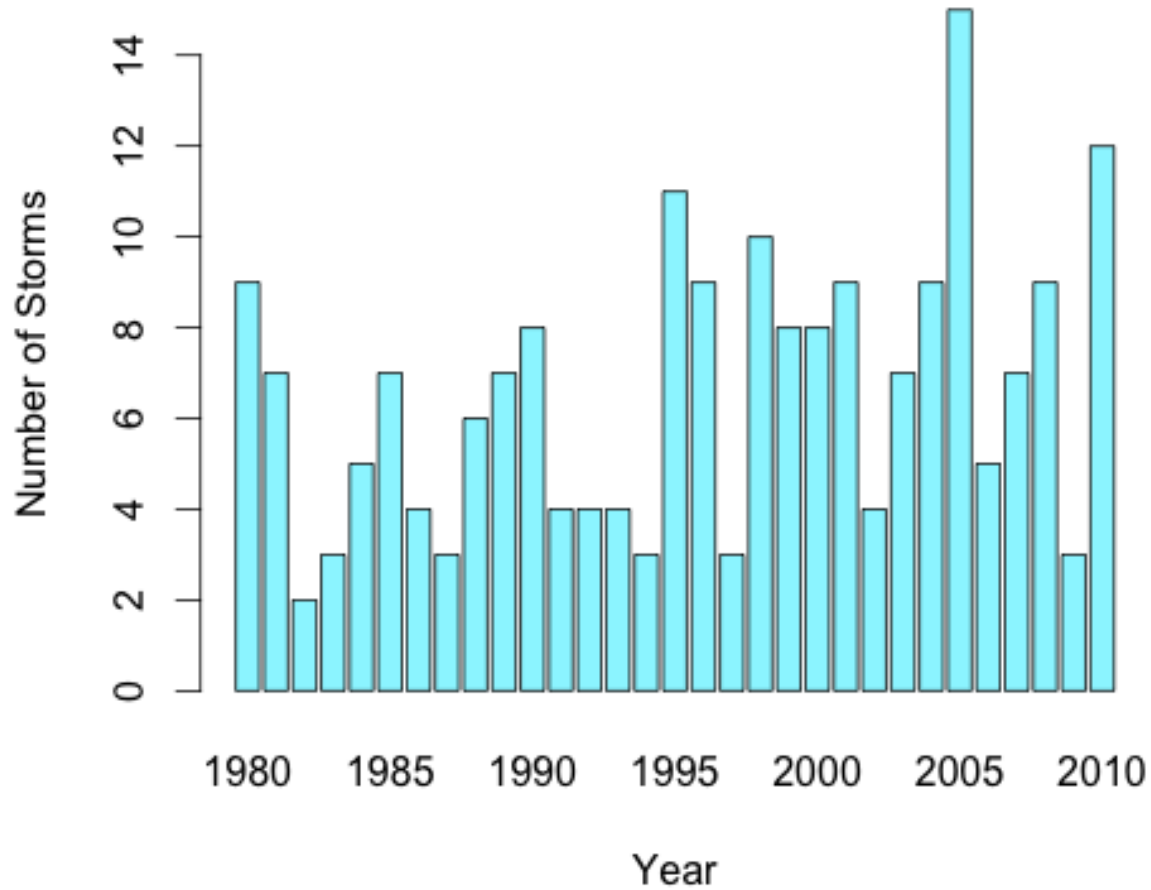
2

Barplot of Storms Per Year with Winds >= 35 Knots
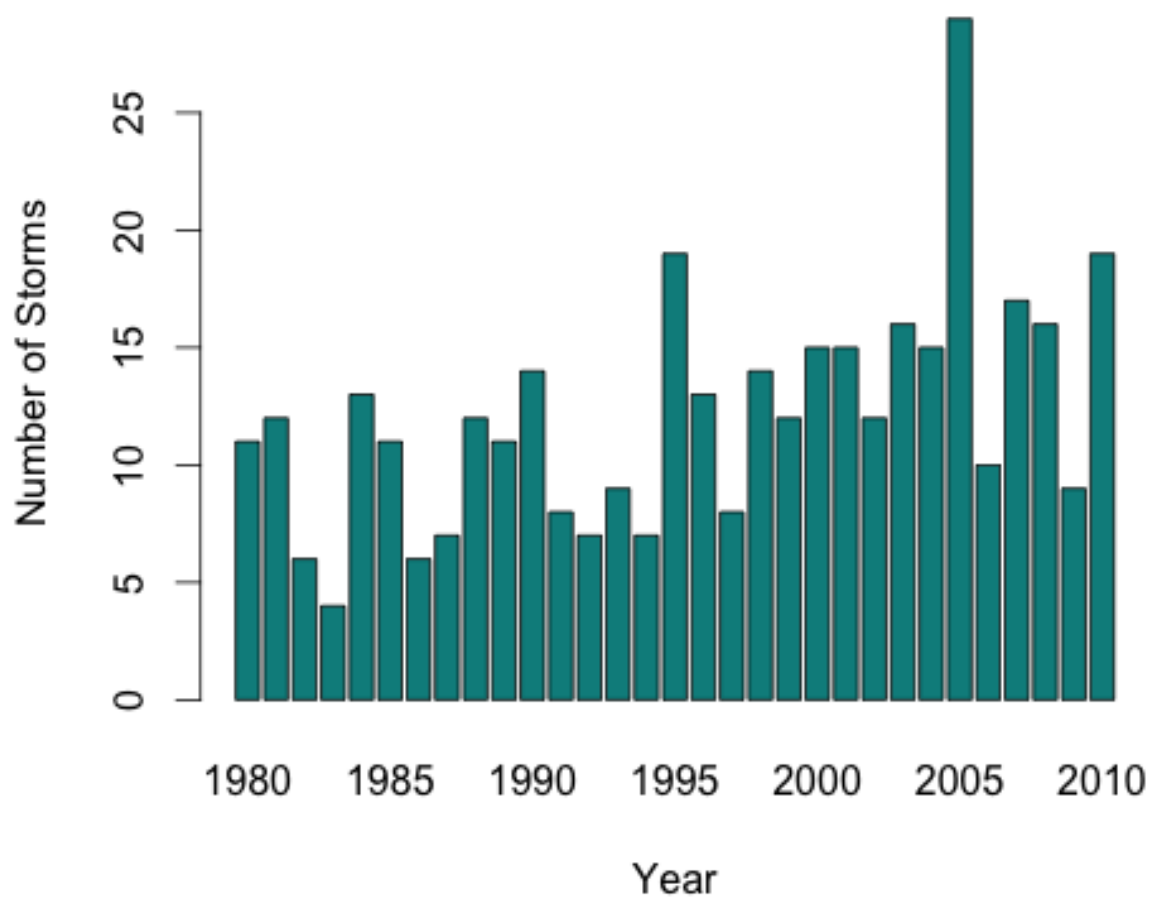
Storms with winds $>= 64$: we can see that the storms with winds $>= 64$ peaked approximately every 5 years.

```
## 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
##    9    7    2    3    5    7    4    3    6    7    8    4    4    4    3
## 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
##   11    9    3   10    8    8    9    4    7    9   15    5    7    9    3
## 2010
##   12
```

Barplot of Storms Per Year with Winds >= 64 Knots

Storms with winds >= 96: we can see that there aren't very many storms with winds >= 96. Looking at each decade, we can see that the hurricane trajectories increased every decade.

```
## 1980 1981 1982 1983 1984 1985 1987 1988 1989 1990 1991 1992 1993 1995 1996
##    2    3    1    1    1    3    1    3    2    1    2    1    1    5    6
## 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
##    1    3    5    3    4    2    3    6    7    2    2    5    2    5
```
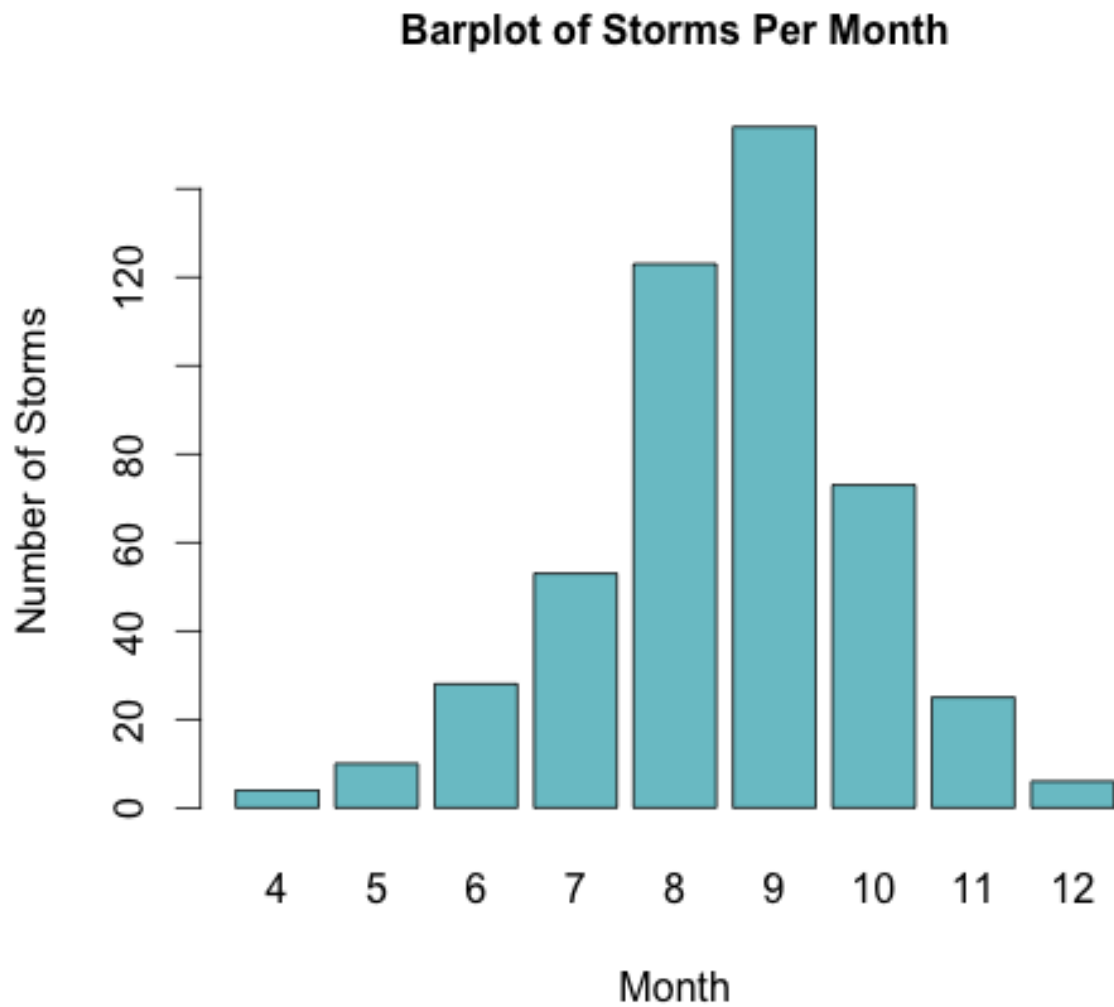
Barplot of Storms Per Year with Winds >= 96 Knots
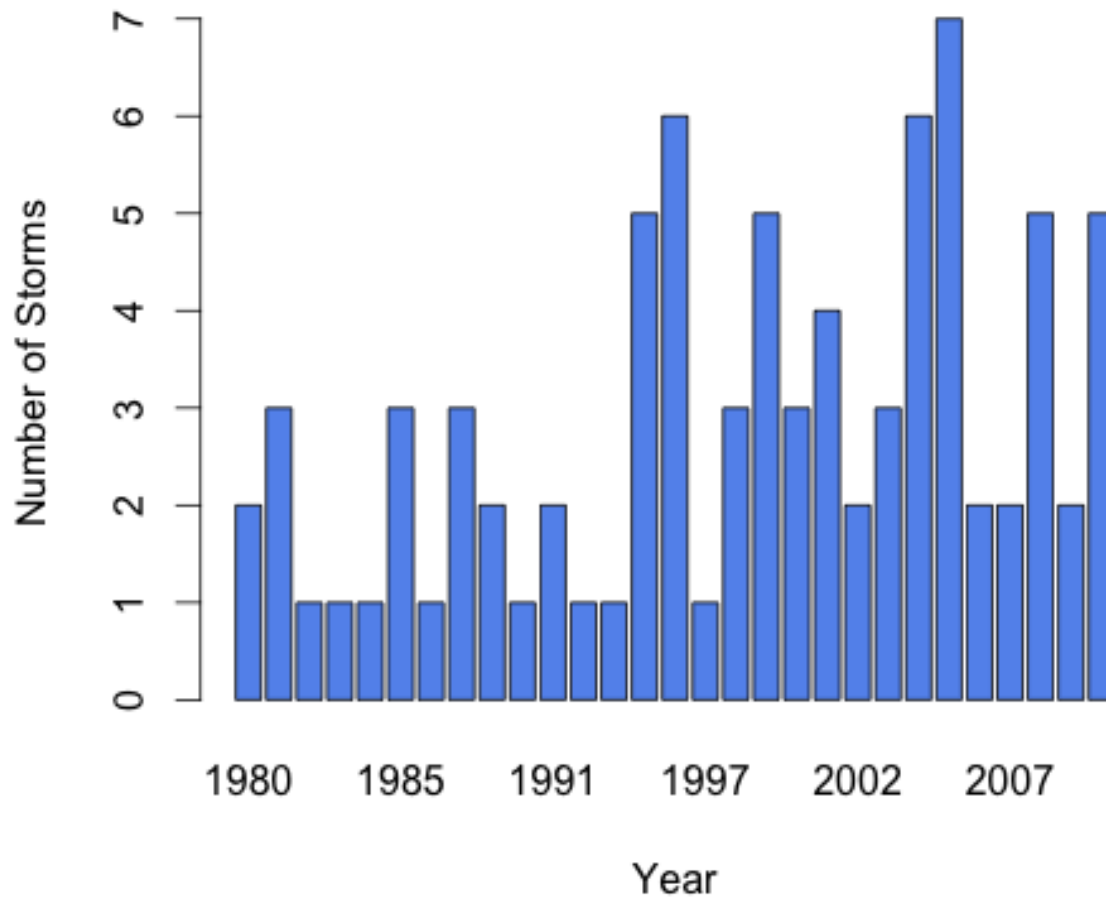
Storm Analysis Per Month

Storms per month: we can see that there are the most storms in the middle of the year, particularly in August and September.
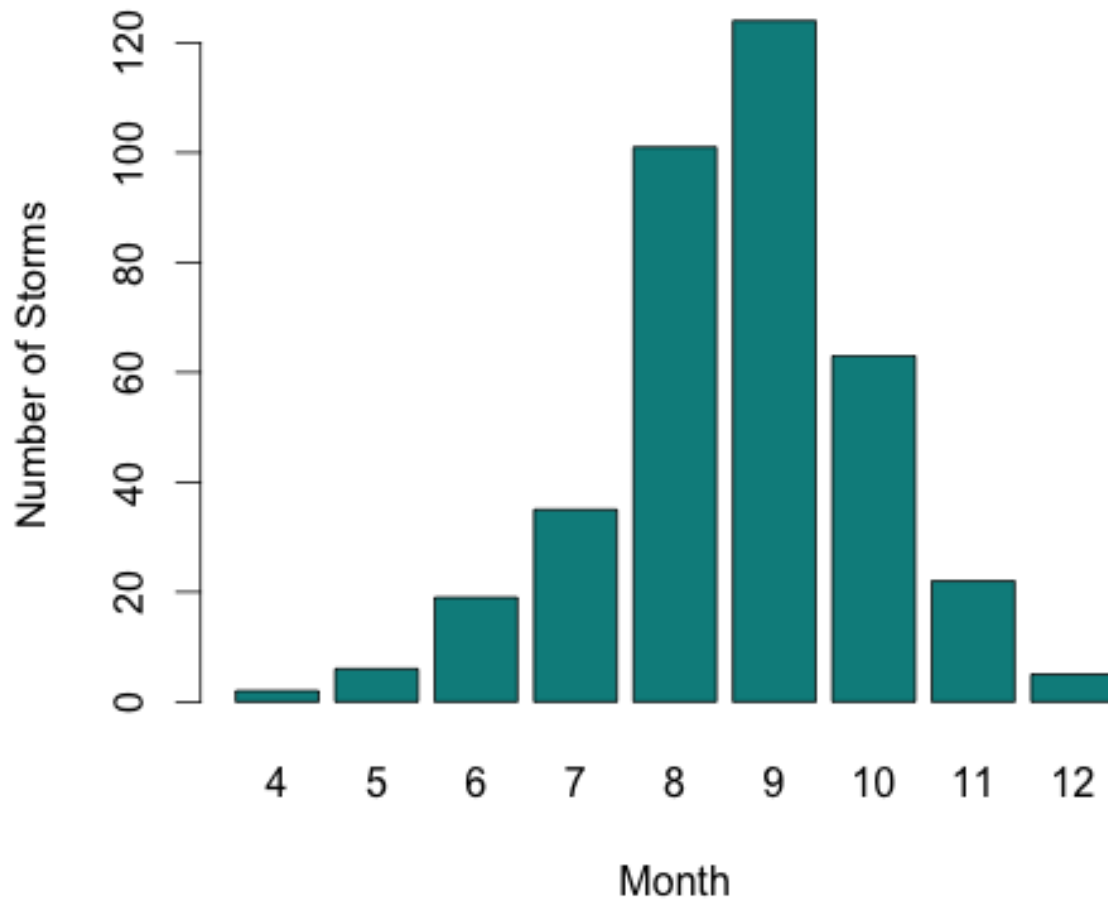
```
## stormspermonth
##   4   5   6   7   8   9  10  11  12
##   4  10  28  53 123 154  73  25   6
```

Barplot of Storms Per Month

Storms with winds >= 35: we can see that the storms with winds >= 35 peak in August and September. The difference from July to August and September to October is by about 70 storms

```
##    4    5    6    7    8    9   10   11   12
##    2    6   19   35  101  124   63   22    5
```
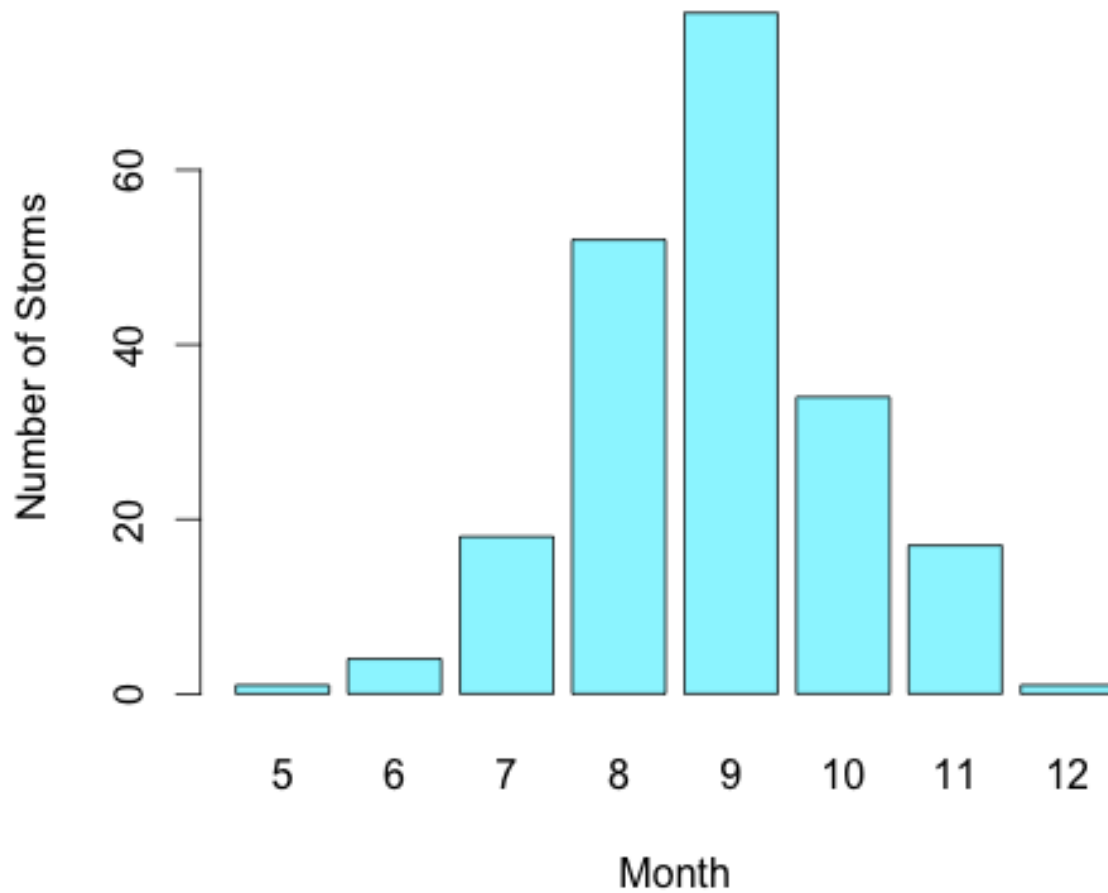
Barplot of Storms Per Month with Winds >= 35 Knots

Storms with winds >= 64: we can see that the storms with winds >= 64 also peak in August and September, but the storm difference from July to August and September to October decreased to approximately 40 storms. This pattern makes sense because it is less likely to have more stronger storms than weaker storms

```
##  5  6  7  8  9 10 11 12
##  1  4 18 52 78 34 17  1
```

Barplot of Storms Per Month with Winds >= 64 Knots

Storms with winds >= 96: we can see that the storms with winds >= 96 are significantly less frequency than storms per month by speeds 35 or 64. As observed from the chart, strong storms do not occur very often, but when they do, it peaks in August and September. The difference from July to August and September to October is about 30 storms.

```
##   7  8  9 10 11
##   6 25 40  9  3
```

## Barplot of Storms Per Month with Winds >= 96 Knots
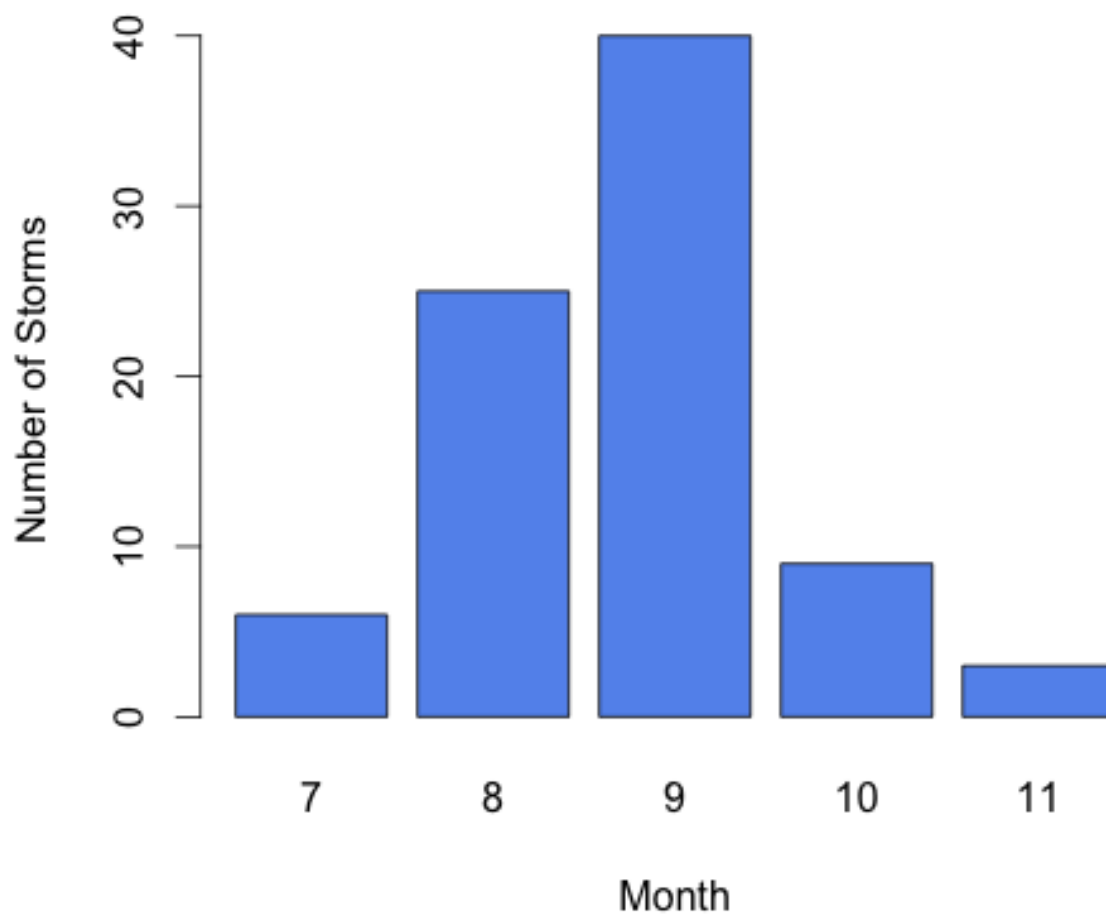
Average storms by wind speed:

```
##   row_name      mean  std dev 25th 50th 75th
## 1 35 knots 12.161290 4.993975  8.5   12   15
## 2 64 knots  6.612903 3.116381  4.0    7    9
## 3 96 knots  2.862069 1.787339  1.0    2    4
```

Regression Analysis

Regression Analysis: We can see that the mean and median wind speeds and pressures has a linear correlation

Mean Pressure and Wind Speed Per Storm

**Median Pressure and Wind Speed Per Storm**
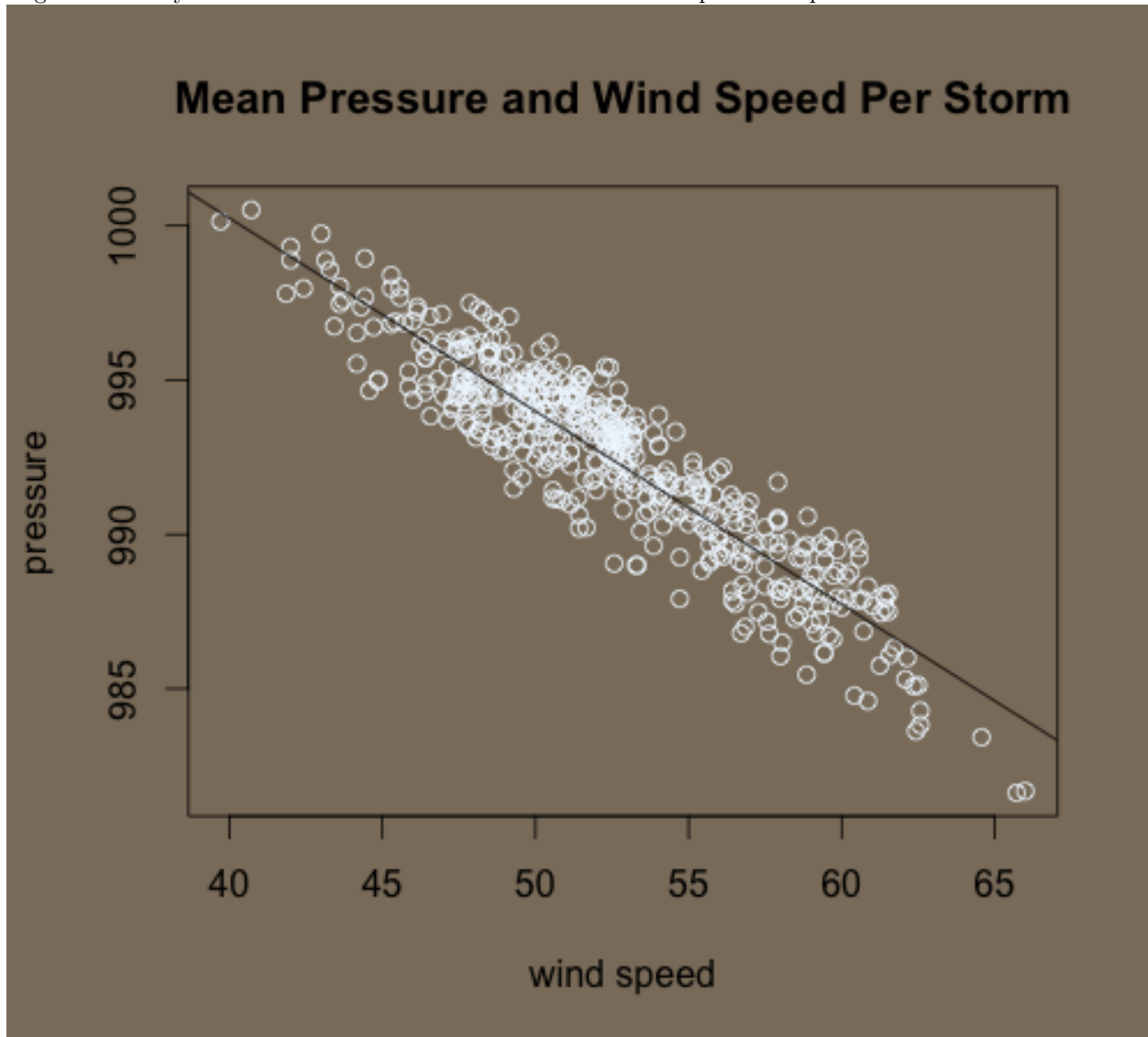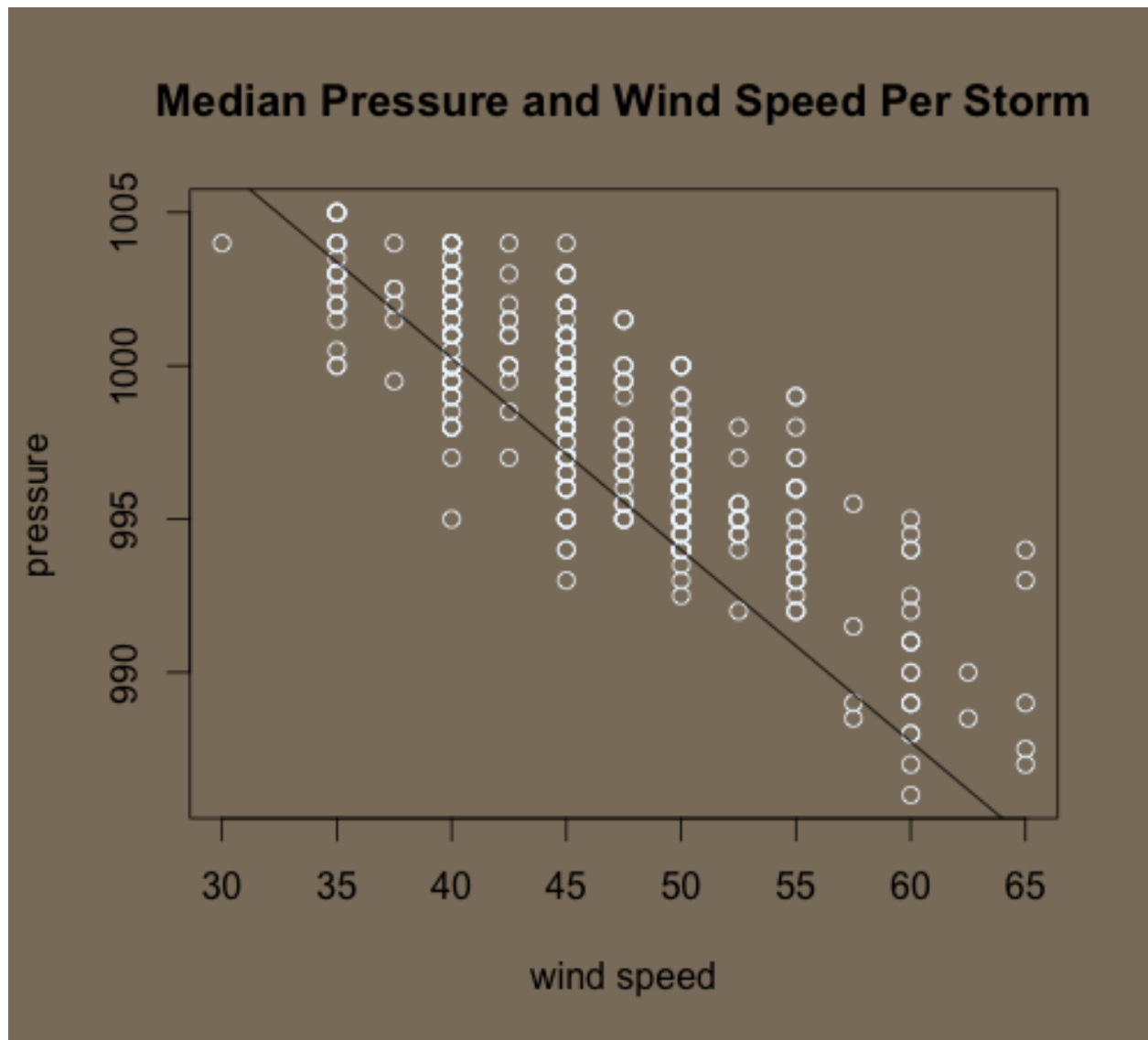
World Map Analysis

Map Analysis by Year: here we can see several storms occured in the North Atlantic and East Pacfic Basins, with more concentrated winds in the East Pacific Basin and more interspersed winds in the North Atlantic
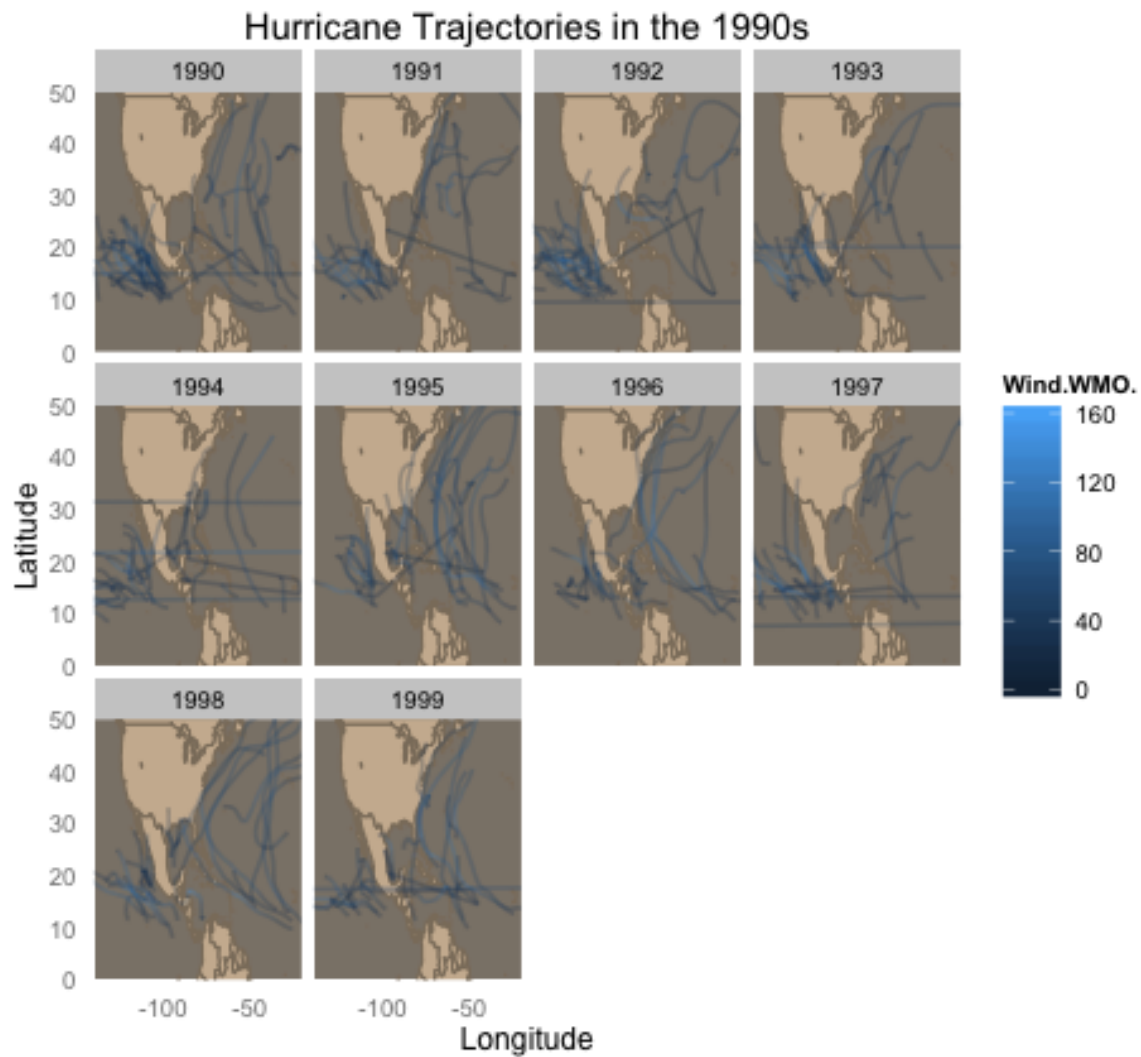
Hurricane Trajectories from 1980-2010
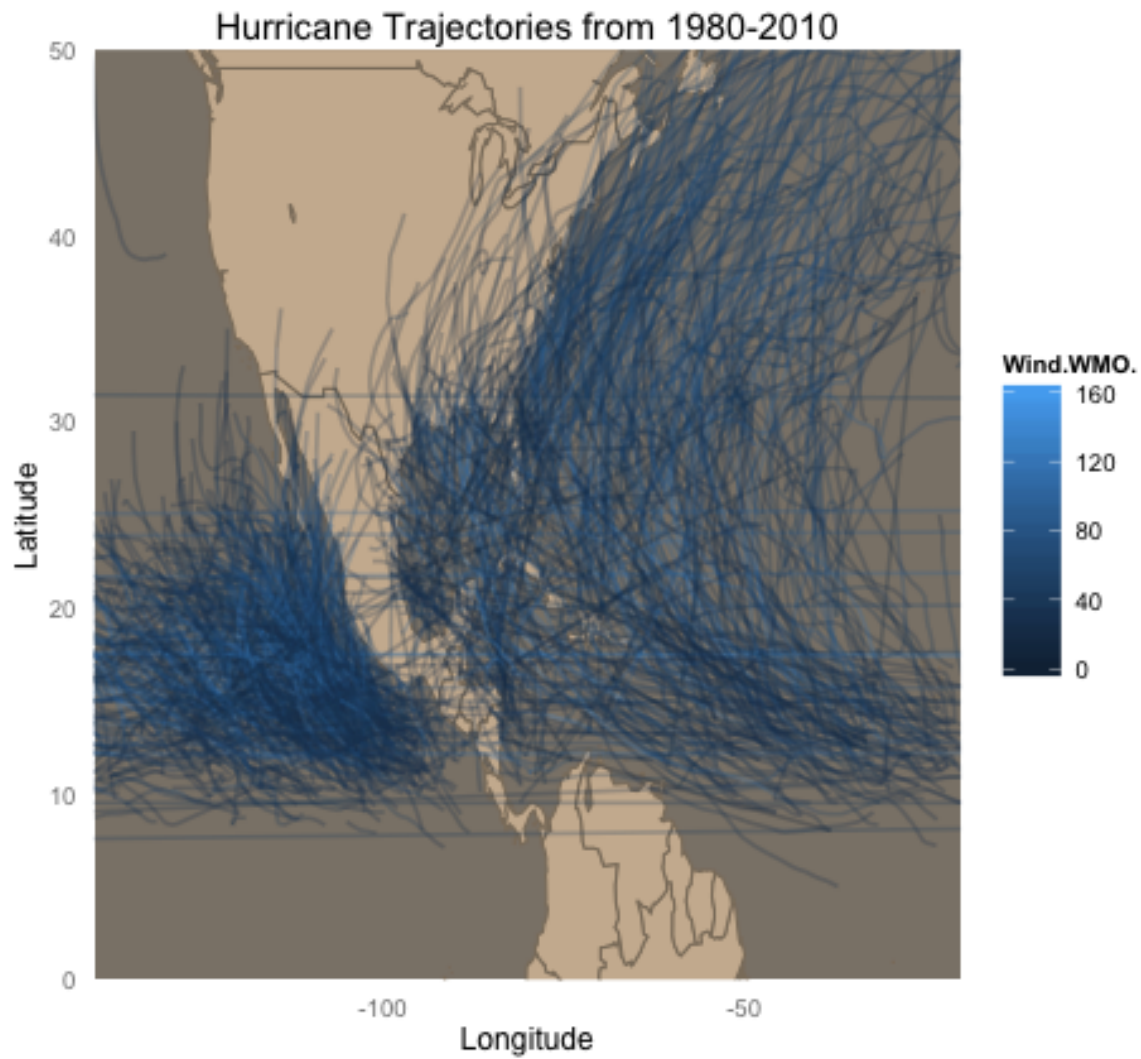
Map Analysis by Month: here we can see that the wind trajectories occur more frequently from July to October. We can thus conclude that hurricane season occurs during those months

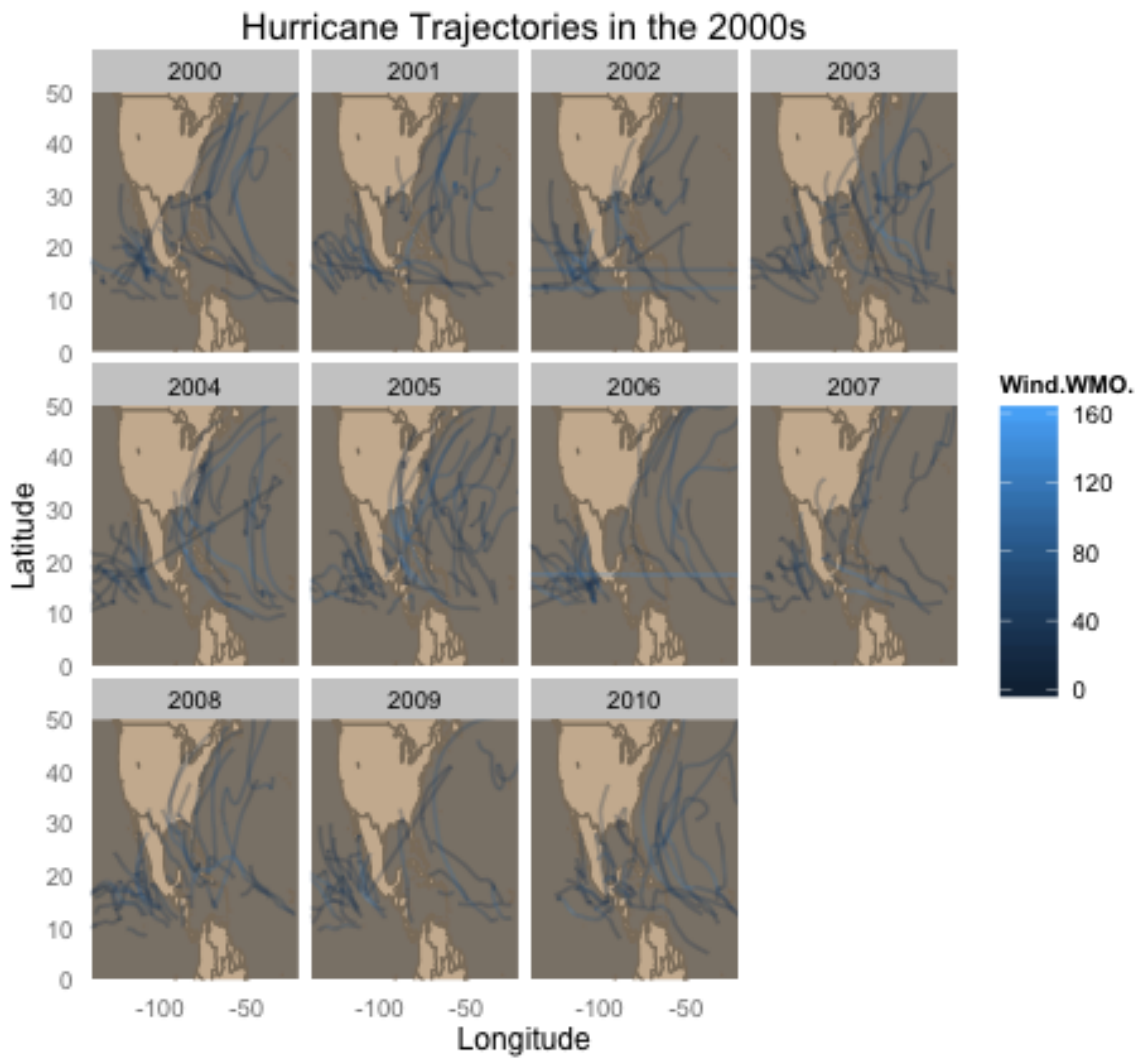## Hurricane Trajectories by Month from 1980-2010
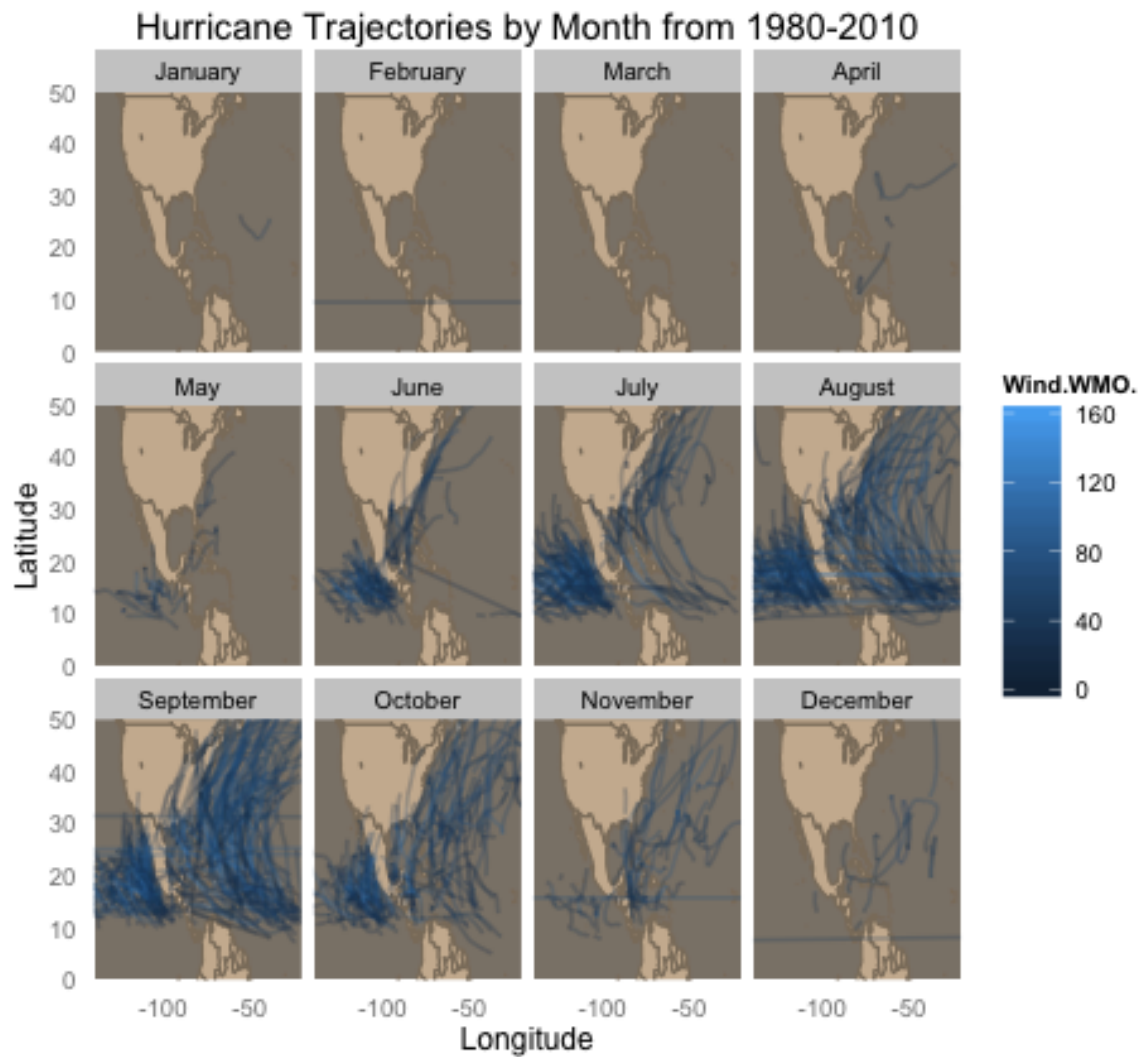
Map Analysis in the 1980s: here we can see that not very many hurricanes occurred during this decade. The wind trajectories are spread out, with no year that is particularly prominent
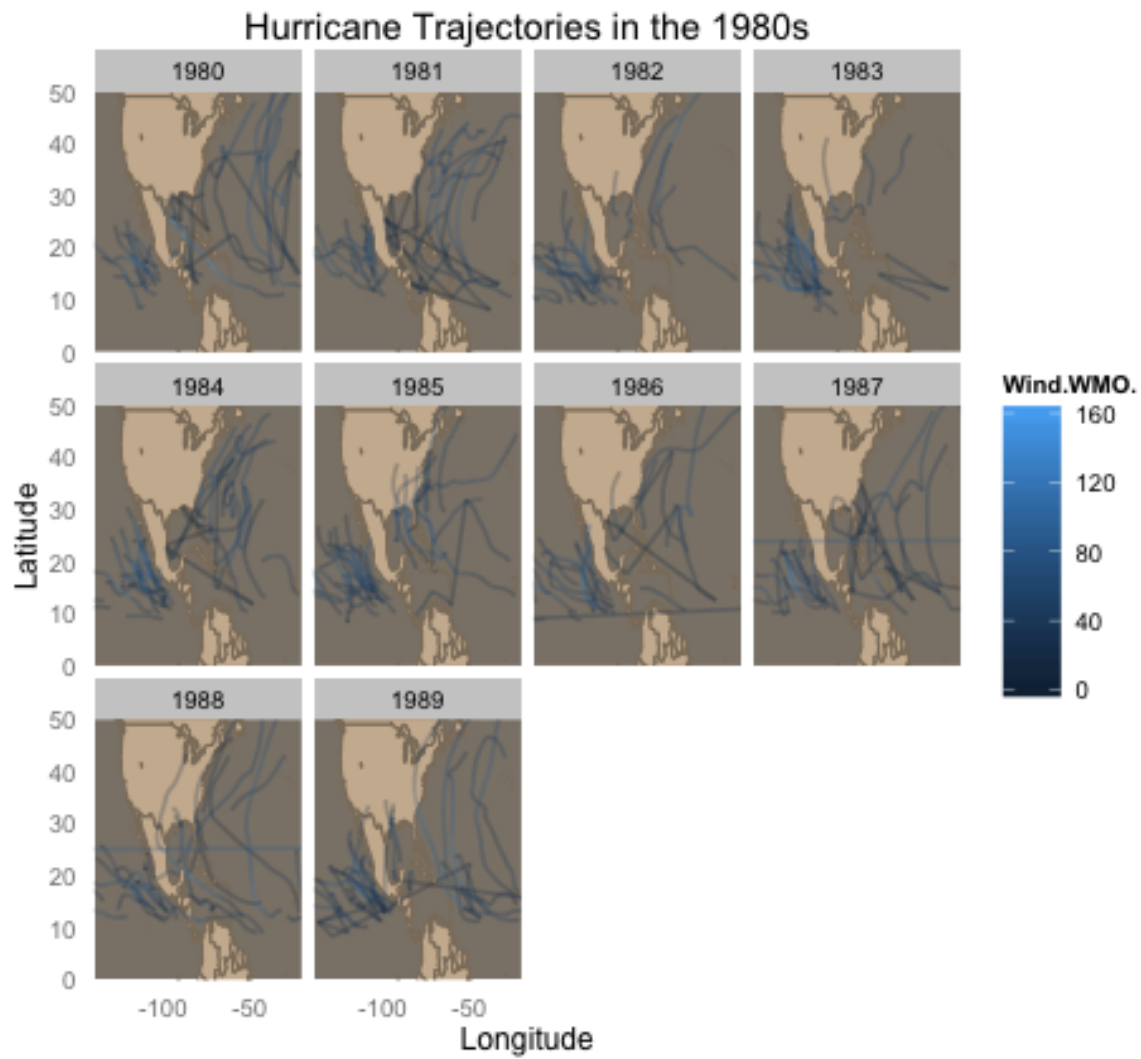
Map Analysis in the 1990s: from 1990-1993 there are more concentrated storms that occur in the East Pacific Basin, whereas in 1994-1999, there are more storms in the North Atlantic Basin

Hurricane Trajectories in the 1990s

Map Analysis in the 2000s: the storms seem to occur more on the North Atlantic, with heavier storms in 2005, when Hurricane Katrina occured. The hurricane trajectories throughout the rest of the decade is consistent oth-

Hurricane Trajectories in the 2000s

erwise.